

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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In re Application of:

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George G. Zipfel, Jr. et al

Attorney docket No: Zipfel 1

Serial No.: 10/783,499

Art Unit: 2817

Filed 02/20/2004

Examiner: SHINGLETON, Michael B.

Title: SWITCHING AMPLIFIER FOR DRIVING REACTIVE LOADS

COMMISSIONER FOR PATENTS
ARLINGTON, VA 22313

SIR:

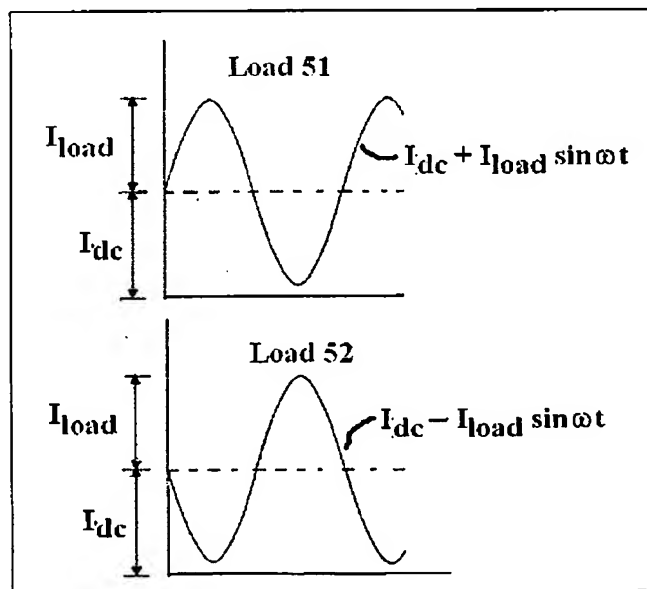
DECLARATION UNDER 37 C.F.R. 132George G. Zipfel, Jr. residing at 164 Canoe Brook Parkway, Summit, New Jersey,
hereby declares as follows:

1. I have been employed by Summit Applied Research, Inc from 1996 to the present, designing electronics, active vibration control, acoustic systems R&D for DARPA and US Navy
2. I was employed by AT&T Bell Laboratories, Inc., designing electronics, transducer, active vibration control, sonar, system and subsystem R&D for the US Navy, US Air Force, and DARPA from 1973 to 1996
3. I was a National Research Council Postdoctoral Research Associate at Naval Research Laboratories, acoustic systems and analysis from 1971 to 1973
4. I was Post Doctoral Research Associate at SUNY Stonybrook, NY from 1968-1971.
5. I received PhD in Physics, University of Michigan, Ann Arbor, MI in 1968.
6. I received MSE in Electrical Engineering, University of Florida, Gainesville, FL: in 1962
7. I received BS in Electrical Engineering, MIT, Cambridge, MA in 1961
8. I received BS in Physics, MIT, Cambridge, MA in 1960
9. This document relates to the outstanding rejection in the Office action mailed 03/09/2007 of all the claims of the above-identified patent application as being unpatentable under 35 U.S.C. 102-103.

I. Sum of the Currents is Zero—Claims 1, 15, 64

10. Contrary to claims 1, 15 and 64, the sum of the values of the instantaneous currents (which includes dc) through the loads in Prokin does not, and cannot sum to substantially zero. This can be seen in several ways:

- a. In order for the Prokin circuit to do any useful work—that is, in order for the loads in Prokin to generate any acoustic energy, there must be a net dc current through power supply 1 (Prokin's only power supply). Otherwise the power supply delivers no energy to the circuit. But if the sum of the values of the instantaneous currents through loads 51 and 52 (which Prokin calls "phases") were to be substantially zero, then by Kirchoff's Current Law, there would in fact not be any net dc current flow out of power supply 1 which, as just noted, cannot be the case. Thus the sum of the values of the instantaneous currents through load phases 51 and 52 must be other than substantially zero.
- b. There are identical dc components through load phases 51 and 52, as stated by Prokin (e.g., col. 8, lines 19-20). However, the modulated current components through the load phases 51 and 52 are in opposite directions (e.g., col. 8, lines 33-35) but are of equal value (col. 8, line 42). Thus the currents through the two load phases are $(I_{dc} + I_{load} \sin \omega t)$ and $(I_{dc} - I_{load} \sin \omega t)$, where I_{dc} is the dc component, I_{load} is the amplitude of the modulating current and ω is its frequency. Adding these together yields the current $2I_{dc}$ which is non-zero.
- c. This can also be seen in the graph below, from which it is apparent that forming the sum of the instantaneous currents through the two load phases results in the equal-and-opposite modulated currents canceling each other



while the equal and not-opposite dc components I_{dc} combine in a positive way to result in a sum of $2I_{dc}$.

- d. The above analysis is also consistent with the observation in Prokin that "average current values through both phases 51 and 52 are directed from the power supply 1 [col. 8 lines 25-26]."

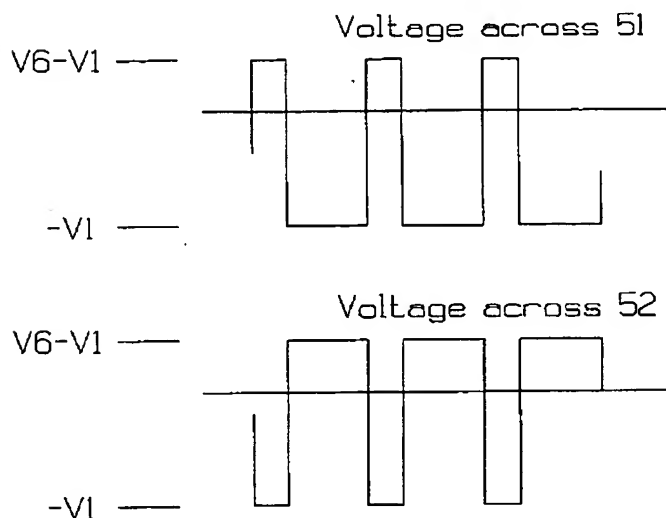
II. Same Amount of Current Flowing out of One Load
Flows into the Other—Claims 9, 34, 63

11. Contrary to claims 9, 34 and 63, substantially the same amount of baseband current that flows out of one of the loads at a given time in Prokin does not flow into the other.
- a. This can be seen by considering the mathematical representations of the currents through Prokin's load phases 51 and 52 presented above in ¶10b—namely $(I_{dc} + I_{load} \sin \omega t)$ and $(I_{dc} - I_{load} \sin \omega t)$ which, of course, are not the same amount of current at any given time.
 - b. This can also be seen based on a similar Kirchoff's Current Law analysis as presented above in ¶10a. Specifically, if substantially the same amount of baseband current (which includes dc, of course) flowing out of (say) load phase 51 did flow into load phase 52, then there could be no current flow out of power supply 1 and with no energy being delivered to the circuit, there could be no acoustic energy generated by the load phases.
 - c. The above graphical representation of the currents through the load phases also demonstrates that the same amount of baseband current that flows out of one of the load phases in Prokin at a given time is different (i.e., not the same) from the amount of baseband current that flows into the other.

III. In-Phase Switching Band Components —Claims 26, 33, 63

12. Contrary to claims 26, 33 and 63, the fundamental switching frequency components of Prokin's two switching signals do not have substantially the same phase. In fact, they are of opposite phase. This can be seen as follows:
- a. Prokin col. 11, lines 22-23 says that in operation capacitor 6 is charged to between a maximum of 2 times the voltage of power supply 1 and $4/3$ the voltage of power supply 1 for a full load. As a consequence the voltage of upper terminal of 6 is always greater than the voltage of the upper terminal of 1. The description of switching in col. 7, lines 60-63 says that there are two states of the circuit: (1) In one state load 51 in fig. 12 has its right-most node connected to the top of 6 and its left most node connected to the top of 1, while at the same time load 2 has its right most node connected to the bottom of 6 and its left most node connected to the bottom of 1. In this

state the voltage across 51 is positive and equal to $V_6 - V_1$, [where I am using the symbol V_6 to mean the voltage stored on capacitor 6 and the symbol V_1 to mean the voltage of power supply 1] while the voltage drop across 52 is negative and equal to $-V_1$, voltage drops being defined by the voltage at the right most node of 51 or 52 minus the voltage at the left most node of 51 or 52 respectively. (2) In the second state the situation is reversed with load 52 in fig. 12 having its right most node connected to the top of 6 and its left most node connected to the top of 1, while at the same time load 51 has its right most node connected to the bottom of 6 and its left most node connected to the bottom of 1. In this second state the voltage across 51 is negative and equal to $-V_1$ while the voltage drop across 52 is positive and equal to $V_6 - V_1$. The figure below shows typical voltage waveforms for 51 and 52.



- b. As can be seen, the square wave signal across 51 goes high when the square wave signal across 52 goes low, and vice versa. Thus the fundamental components of those signals have opposite phases to one another, not the same phase as these claims require.

IV. Switching Band Components Cancel or Are Canceled—Claims 24, 33, 38, 39, 63

13. I hereby affirm the technical correctness and arguments presented in the accompanying INTERVIEW SUMMARY and SUPPLEMENTAL RESPONSE TO OFFICE ACTION.

V. Common-Mode Filter—Claims 36-39 and 63-68

14. I hereby affirm the technical correctness and arguments presented in the accompanying INTERVIEW SUMMARY and SUPPLEMENTAL RESPONSE TO OFFICE ACTION.
15. I note in this regard the citation of the Sawashi reference and its teaching that coils 34A and 34B cancel out certain in-phase (i.e., common mode) noise components. The person of ordinary skill in the art would not be led, based on such teachings of Sawashi, to include such circuitry in Prokin connected to load phases 51 and 52. In fact, the person of ordinary skill in the art would be TAUGHT AWAY from including such circuitry in Prokin.
- a. In particular, the significant amount of dc current flowing through load phases 51 and 52 as described above would saturate the core of such a common mode filter—thereby preventing it from acting as a common mode filter for switching frequency components—unless the common mode filter were made large enough that its core would not be saturated.
 - b. But a common mode filter big enough to avoid such saturation would be bigger, more complex and more expensive than two separate standard inductors to suppress switching frequency energy, which is in fact what Prokin does do, e.g., inductors 41 and 42 in figure 15. This is why the person of ordinary skill would not be led to include an common mode filter in Prokin.
 - c. The above-noted situation relative to core saturation does not obtain in Sawashi because, other than the low current common mode noise that Sawashi wishes to cancel, the only other signals applied to Sawashi's common mode filter are differential mode signals, which do not saturate the core.

VI. Common-Mode Filter Cancels Fundamental Switching
Frequency Components—Claims 38, 39 and 63-68

16. Even if there was motivation to include a common mode filter in Prokin based on Sawashi's teachings, such a filter would not be effective to cancel the fundamental switching frequency components, as stated in claims 38, 39, and 63-68. The reason is that the switching frequency signal is a differential mode signal and consequently it would not be affected by a common mode filter which ideally presents zero impedance to a differential mode signal.

17. I hereby acknowledge that I have been warned that any willful false statements and the like are punishable by fine or imprisonment, or both (18 U.S.C. 1001) and may jeopardize the validity of the application or any patent issuing thereon.

18. All statements made of my own knowledge are true and all statements made on information and belief are believed to be true.

/George G. Zipfel, Jr./
George G. Zipfel, Jr.

Dated: 12/07/2007